Devlopment Of Flywheel Using Spring Mass System

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ABSTRACT

The Dual Spring Mass Flywheel is mainly used for dampening of oscillations in automotive power trains and to prevent gearbox rattling. We explain the dual spring mass flywheel mechanics along with its application and components. afterwards a detailed initial model of the dual spring mass flywheel dynamics is prepared. This mainly includes a model for the two arc springs in the dual spring mass flywheel and their friction behavior. in cooperation centrifugal effects and redirection forces act radially on the arc spring which induces friction. An experimental the dual spring mass flywheel model is compared to measurements for model validation. Finally the observation of the engine torque using the dual spring mass flywheel is discussed. For this function the dual spring mass flywheel is manufactured and done experiment or testing to see the results. And then results are comparing with the conventional flywheel. The objective when developing the Dual Mass Flywheel was therefore to isolate torsional vibration from the drive train as much as possible caused by the engine's rotating mass. Due to its integral spring/damper system, the Dual Mass Flywheel almost entirely absorbs this torsional vibration. The result is Very good vibration damping. Flywheel inertia is stored when you rev the engine slightly before letting the clutch out - this minute amount of extra power helps in getting the motorcycle underway with minimal effort. By "borrowing" power for a few seconds, the engine has to develop less to move from a standing start. Once the clutch is fully engaged, inertia can no longer be borrowed - the motorcycle can only use what it produces in "real time"

Keyword : - *Torsional Vibrations,Dual Spring Mass Flywheel,Energy Storage Capability*

1. INTRODUCTION-1

A flywheel is a rotating mechanical device that is used to store rotational energy. Flywheel has significant moment of inertia and thus resists changes in rotational speed. The amount of energy stored in a flywheel is proportional to the square of its rotational speed. Energy is transferred to a flywheel by applying torque to it, thereby increasing its rotational speed, and hence its stored energy. Conversely, a flywheel releases stored energy by applying torque to a mechanical load, thereby decreasing its rotational speed.

Flywheels are often used to provide continuous energy in systems where the energy source is not continuous. In such cases, the flywheel stores energy when torque is applied by the energy source (here 2 stroke-engine), and it releases stored energy when the energy source is not applying torque to it. For example, a flywheel is used to maintain constant angular velocity of the crankshaft in a reciprocating engine. In this case, the flywheel which is mounted on the crankshaft stores energy when torque is exerted on it by a firing piston, and it releases energy to its mechanical loads when no piston is exerting torque on it. Other examples of this are friction motors, which use flywheel energy to power devices such as toy cars.

1.1Dual Spring Mass Flywheel.

The rapid development of vehicle technology over the last few decades has brought ever higher performance engines paralleled by an increased demand for driver comfort. In addition, lean concepts, extremely low-speed engines and new generation gearboxes using light oils contribute to this. Since the middle of the 1980s, this advancement has pushed the classic torsion (spring mass) damper as an integral part of the clutch driven plate to its limits. With the same or even less installation space available, the classic torsion damper has proved inadequate to outbalance constantly increasing engine torques. Extensive development by LuK resulted in a simple, but very effective solution – the Dual Spring Mass Flywheel a new torsion damper concept for the drive train shown in fig.1.

The dual-mass flywheel is actually a great piece of engineering. This relatively new piece of equipment has been a 'must have' fixture to most modern day engines as standard equipment. Any engine that is properly balanced is prone to vibration in a number of ways. These vibrations are almost impossible to eradicate due to the repetitive and stringent combustion forces acting on the pistons, connecting rods and crankshaft at regular intervals as per the firing order of a particular engine. The most damaging of these vibrational modes experienced is torsional and the effect gets worse at the lower engine RPM range.

The torsional frequency is defined as the rate at which the torsional vibration occurs. When the torsional frequency of the crankshaft is equal to the transaxles torsional frequency an effect known as the torsional resonance occurs. The vibration caused by the torsional resonance when the operating speed of the engine is low can be avoided using dual mass flywheel. [2] In manual transmission, the vibration of engine torque causes rattle noise due to backlash between teeth of transmission gears. While booming noise is generated due to resonance which is produced when vibration frequency of engine matches with natural frequency of transmission. Hence it becomes interesting and worth to study DMF component design and comparison of DMF with conventional flywheel on the basis of speed, torque, power and efficiency.

A standard DMF is as shown in Fig. 2. It consists of the primary flywheel and the secondary flywheel. The three decoupled masses are connected via a spring/damper system and supported by a deep groove ball bearing so they can rotate against each other. The primary mass with starter ring gear is driven by the engine and tightly bolted to the crankshaft. It encloses, together with the primary cover a cavity which forms the arc spring channel.
At the heart of the torsion damper system are the arc springs. They sit in guides in the arc spring channels and cost effectively fulfills the requirements of an "ideal" torsion damper. The guides ensure correct guidance of the springs during operation and the grease around the springs reduces wear between the guides, channels and the springs. Torque is transferred via the flange. The flange is bolted to the secondary flywheel with its wings sitting between the arc springs. The secondary flywheel helps to increase the mass moment of inertia on the gearbox side. Vents ensure better heat dissipation

2. Problem Statement

In an ordinary conventional flywheel the engines˙ignition-induced rotational speed irregularity causes torsional vibration in the vehicles driveline also the fluctuations in engines speed. At a given speed the ignition frequency is equal to the natural frequency of the driveline so that extremely high vibrations amplitudes occur that causes rattle in transmission. Also more mass of flywheel increases the cost of engine.

2.1Proposed Methodology

The arrangement of the dual mass flywheel is best explained by the mathematical model below. The model is a two spring two mass model graphically represented as below

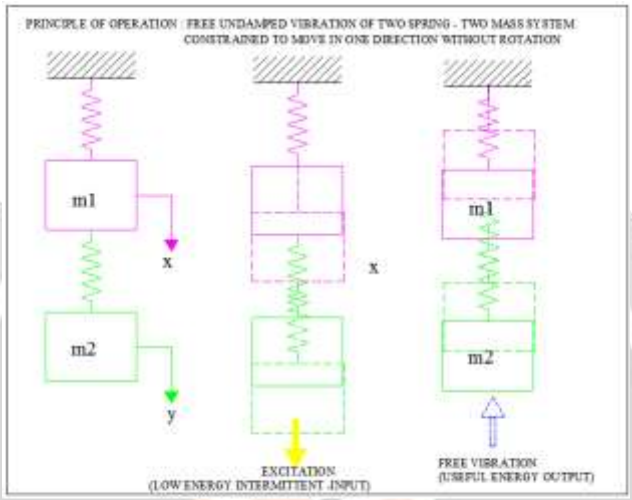
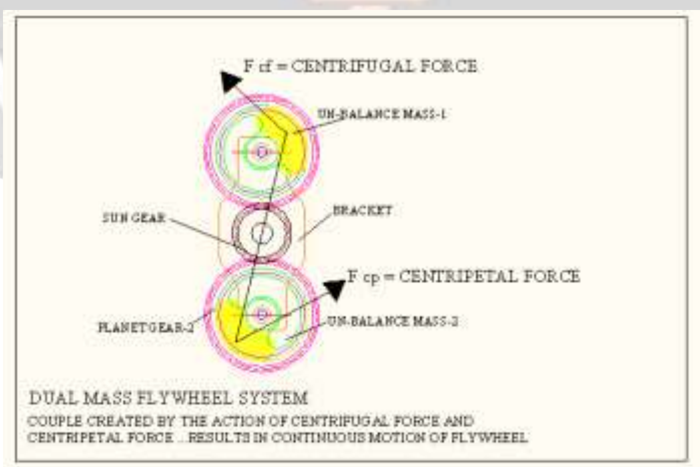


Fig 2: Model Of Two Spring Two Mass

The fig. 2 shows free un-damped vibrations set up of two mass- two spring system. As shown in the figure the input to the system is in the form of an low energy intermittent input from any power source (excitation) , this results in free undamped vibrations are set up in the system resulting in the free to and fro motion of the mass (m1)& (m2) , this motion is assisted by gravity and will continue until resonance occurs, i.e., the systems will continue to work long after the input (which is intermittent) has ceased. Hence the term free energy is used.



From Fig .3 it is clear that in addition to the mass of the flywheel , the couple owing to the centrifugal and centripetal forces keeps the flywheel into motion for longer time thereby increasing the work done by the system hence theoutput from the given system increases

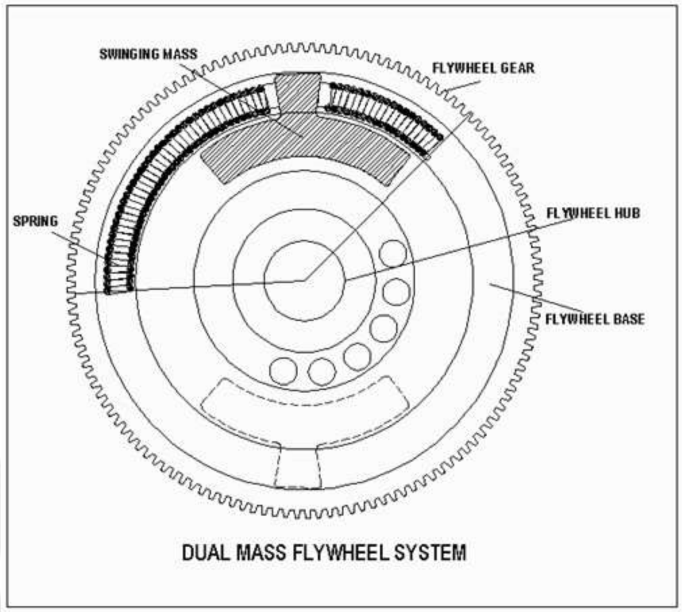


Fig.:Actual Spring Mass Flywheel

3. LITERATURE REVIEW:

1) Govinda A., Dr. Annamalai K.(2014)-In this paper, Dual mass flywheel is a multi-clutch device which is used to dampen vibration that occurs due to the slight twist in the crankshaft during the power stroke. The torsional frequency is defined as the rate at which the torsional vibration occurs. When the torsional frequency of the crankshaft is equal to the transaxles torsional frequency an effect known as the torsional resonance occurs. When the operating speed of the engine is low, vibration occurs due to the torsional resonance and this can be avoided using dual mass flywheel. This work is carried out to study the effect of arc springs on the dual mass flywheel. The main aim is to increase durability of the arc spring and to elimination of gear rattle. A three dimensional model of a single arc spring, hard-soft spring combinationand single mass with arc springs are optimized by modal analysis and fatigue analysis using ANSYS.
2) Sung K. Seong J. Kim, Sana U. Sang C. Han(2012)-This paper discusses three different rim design cases of a hybrid composite flywheel rotor using strength ratio optimization. The rotor is composed of four hybrid composite rims. These rims are made from carbon glass with carrying volume fraction of hoop wound reinforcements. Optimization is performed to reduce the maximum strength ratio during two states: stationary and the maximum allowable rotational speed. The input specifications for optimization are: maximum useable energy, rotational speed, height and inner radius. In the first case, the rims are wound simultaneously by continuous winding. However, in the second case, the rims are wound separately, and interference is incorporated for their assembly by press fit. In the third case, a hybrid version of the first two cases is used, whereby two pairs of rims are wound at the same time, and in a secondary operation, the first pair is press fitted to the second pair. Each case has different fabrication costs and different strength ration. The third case rotor has been successfully manufactured by filament winding with in situ curing, followed by press fit assembly of machine rims.

3) Paul D. Walker, Nong Zhang(2013)-In this paper, Popular methods for simulation of shift control in dual clutch transmissions rely on two assumptions, (1)the application of minimal degrees of freedom for the power train model, and (2) the use of mean torque engine models to describe engine torque. To study the influence of engine torque harmonics, model degrees of freedom, and dual mass flywheels on the transient

response of a vehicle power train equipped with a dual clutch transmission two power train models are presented. Four degree of freedom and 15 degree of freedom models are compared using free vibration analysis and shift transient simulations. Models are then extended to include an engine model with torque harmonics resulting from piston-by-piston firing of the engine with and without the addition of a dual mass flywheel to study the impact on power train response. Results indicate that degrees of freedom, engine model, and flywheel model all contribute significantly to variance in power train response under each configuration.[4]

4) Li Quan Song, Li Ping Zeng, Shu Ping Zhang, Jian Dong Zhou, Hong En Niu(2014)-In this paper new model or structure of dual mass flywheel with continuously variable stiffness is proposed based on compensation principle in order to release the impact produced by the step changes of stiffness. By theoretical as well as experimental. The proposed structure and design involved are proved to be feasible for reducing the torsional vibration of the power transmission system for automobile with large power and high torque engine. The natural characteristics of the vehicle power transmission system carrying the dual mass flywheel are analysed to investigate the influence of torsional stiffness stiffness on the first order and the second order speed. The result show that this new dual mass flywheel can lower the idle speed of the engine, realize high torque at a large torsional angle, and avoid the impact due to the abrupt changes of stiffness. An inertia balance mechanism is proposed to eliminate the inertia forces produced by moving parts of the device, which can successfully put the torque compensation theory into engineering practice

4. CONCLUSIONS

Use of Dual Spring Mass flywheel improves effectiveness and in turn improves Engine performance characteristics such as speed, torque, power and efficiency. Thus a vehicle loaded with this advanced DSMF, offer increased fuel economy

5. ACKNOWLEDGEMENT

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6. REFERENCES

[1] Bjorn Bolund, Hans Bernhoff, Mats Leijon, "Flywheel Energy And Power Storage Systems", Renewable And Sustainable Energy Reviews, 11(2007) PP235-258.

[2] Jordan Firth, Jonathan Black, "Vibration Interaction In A Multiple Flywheel System", Journal Of Sound And Vibration, 331(2012) PP1701-1714.

[3] Paul D. Walker*, Nong Zhang, "Modelling Of Dual Clutch Transmission Equipped Powertrains For Shift Transient Simulations", Mechanism And Machine Theory, 60 (2013) PP47-59.

[4] Li Quan Song, Li Ping Zeng, Shu Ping Zhang, Jian Dong Zhou, Hong En Niu, "Design And Analysis Of Dual Mass Flywheel With Continuously Variable Stiffness Based On Compensation Principle", Mechanism And Machine Theory, 79(2014) PP124-140.

[5] Govinda, A, Dr. Annamalai, K. "Design And Analysis Of Arc Springs Used In Dual Mass Flywheel", International Journal Of Engineering & Technology Research Volume-2, Issue-1, January-February, 2014.